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THE INFLUENCE OF TEACHERS' COGNITIVE STYLES ON THEIR TEACHING STRATEGIES

Duro Ajeyalemi

Department of Curriculum Studies

University of Zimbabwe

&

Olanitemi O. Busari

Science and Mathematics Department

*Nigerian Education Research and Development Council
(NERDC)*

ABSTRACT

This study examines the influence of teachers' cognitive styles on their teaching strategies. The Cognitive Style Test (Kagan, Moss and Siegel, 1963) was used to group 15 secondary school Chemistry teachers into analytical and relational cognitive style dimensions and four lessons of each of the 16 teachers were observed over a period of eight weeks using the Science Teaching Observation Schedule (Eggleston, Galton and Jones, 1975). Results indicate positive relationships between teachers' cognitive styles and their teaching methods. The analytical teachers favoured factual presentation while the relational teachers preferred the experimental approach of teaching.

A major implication of the findings is that the identification of prospective and serving teachers' cognitive styles may aid teacher educators in planning appropriate programmes for both pre- and in-service training of teachers.

INTRODUCTION

For effective cognitive interactions in the classroom the teacher's preferred style of teaching plays a predominant role. The guided-inquiry approach recommended for science teaching in Nigerian schools, enables the learner to direct and control his own learning under the guidance of the teacher (STAN, 1975; Fish and Goldmark, 1966). The students can only do this successfully if the teacher provides the climate and conditions necessary, structures the process, organises the sequence and assists the students in evaluating their own progress (Busari, *in Press*). However, results of studies in Nigerian science classrooms reveal a predominant expository pattern of cognitive interactions (Ajeyalemi, 1981; Shuaibu, 1979; Teibo, 1975) and this has been suggested as contributing to students' continuing poor performance. This observed pattern had been attributed to certain contextual factors, among which are the inadequate supply of teaching/learning facilities and qualified teachers, over-dependence on recommended textbooks, and large class sizes (Bajah, 1985; Akinmade and Adisa, 1984; Ajeyalemi, 1983).

Notwithstanding, Ajeyalemi and Busari (1986) observed that even with adequate facilities, most chemistry teachers in Nigeria still employ the lecture method while large class size was shown not to have any adverse effect on students' performance (Alonge, 1986). It must then mean some other factors may be intervening to make science teachers and students interact as observed in the classroom, which ultimately affect students' performance. One such factor suggested by Berkheimer and Lott (1984) is the students' cognitive style, which is the mode in which an individual attends to information or tasks presented to him (Guilford, 1980; Saracho, 1980; Tamir and Kempa, 1978; Kempa and Dube, 1973; Ogunyemi, 1973; Witkin, 1967). It is believed that behaviours resulting from one particular cognitive style mode cut across a variety of tasks and remain relatively stable over time (Coop and Brown, 1970).

Using different instruments, an individual may be categorised as either field dependent, (Witkin, 1950) or as either analytical or relational (Kagan, Moss and Siegel, 1963) in his cognitive style. However, Ajeyalemi and Busari (1988) indicated strong relationships between the two different categorisations; the field-independent being more analytical while the field-dependent was more relational. The analytical individual groups stimuli together on the basis of some inferences about the stimuli without overtly differentiating the element within each stimulus. The relational, on the other hand, groups two stimuli together because of the functional or thematic relationship between them; the criterion used often tells a sort of story about the relationship between the stimuli (Ogunyemi, 1973).

Could the teacher's cognitive style also influence his mode of teaching and consequently contribute to students' poor performance? This question is pertinent since the way a teacher perceives and conceives information may determine the way he presents it. A mismatch between teachers and students in their cognitive styles may then adversely affect students' performance in any subject. Saracho (1980) has suggested that the teacher's cognitive style may not only determine which area of content he chooses to attend to or ignore, but how well he teaches.

Field-dependent social studies teachers have been found to rank discussion as more important than either the lecture or discovery approach (Wu, 1967). But Engelhardt (1975) found no relationship between field-dependence/independence and the intensity and consistency of teaching styles among elementary school student-teachers in a mini-course setting. Thus, results of research on the influence of the teacher's cognitive style on his method of teaching remains inconclusive.

PURPOSE OF STUDY

The present study sets out to determine the relationship between chemistry teachers' cognitive style and their teaching

strategies in the Nigerian classroom context. Such a study would have implications for both pre- and in-service teacher education.

Sample

The subjects for this study were 15 chemistry teachers identified, from an initial stratified sample of 25, as either analytical or relational in cognitive style. Each of them taught Form IV Chemistry in a school with a well-equipped laboratory in Lagos Metropolis. The teachers were all qualified graduate teachers with teaching experience ranging from 5 to 14 years, and four in fact had higher degrees in education. Of the 15, eight were identified as truly analytical and seven were relational in cognitive style.

Instrument

Three instruments used for collecting data were: the *Cognitive Style Test* (CST; Kagan, et al.; 1963) for grouping the teachers into analytical and relational styles; the *Science Teaching Observation Schedule* (STOS; Eggleston, Galton and Jones, 1975) for determining cognitive teaching styles; a questionnaire, the Teachers Basic Teaching Facilities Scale (TBTFS) developed by the authors.

The CST consists of 20 triads of familiar pictures and respondents were asked to categorise the two that go together in each triad; giving reasons for their choice. A respondent is classified as analytic or relational based on the reasons he gives on each triad. The scoring mode has been described elsewhere (Ajeyalemi and Busari, 1988).

The STOS was designed to record intellectual transactions in science classrooms with a view to defining the typologies of science teaching styles. It is a three minutes-interval sign system consisting of 23 categories of cognitive interactions between teachers, pupils and resources and among pupils. Categories a1-

7 include teacher's questions requiring varying levels of cognitive operations from students, bl-4 and cl-4 are different types of teachers' statements and directives respectively related to the questions; and categories d1-4 and e1-4 are respectively student-initiated consultations and references to the teacher/resources, for objectives as in (b,c) 1-4.

The instrument had been found suitable for the Nigerian science classroom context (Ajeyalemi and Busari, 1986; Ajeyalemi, 1981; Ugwu, 1980).

The TBTFs contains two sections. Section A sought biographical data from the teachers, while Section B requested information on the availability of teaching/learning facilities in each school as well as the chemistry topics already taught and to be taught next.

PROCEDURE

The CST was first administered on the initial sample of 25, from which the final sample of 15 was selected. The TBTFs was immediately administered to each of the 15 teachers to complete within 30 minutes. From the analysis of the TBTFs data, the following three topics not yet taught by all the teachers were identified – Acids, Bases and Salts, Electrolysis and Oxidation-Reduction Reactions.

Each teacher was instructed to plan and teach these topics over an eight-week period, but no specific strategies of teaching were prescribed. Each teacher was observed four times during the eight weeks using the STOS to record observations. In all, 60 lessons were observed and a teacher was observed for not less than 160 minutes.

TABLE 1
THE STOS MEAN PERCENTAGE-USE FIGURE FOR
EACH CATEGORY FOR ALL TEACHERS

STOS Categories	f (N = 15)	Mean % By Category	% All Transactions
a1	184	23.68	5.43
a2	186	23.94	
a3	178	22.91	
a4	72	9.20	
a5	95	12.23	
a6	44	5.66	
a7	18	2.32	
b1	559	60.50	42.13
b2	131	14.18	
b3	186	20.13	
b4	48	5.19	
c1	99	42.12	10.72
c2	91	38.72	
c3	42	7.87	
c4	3	1.28	
d1	75	47.17	7.25
d2	51	32.08	
d3	29	18.24	
d4	4	2.54	
e1	60	61.22	4.47
e2	21	21.43	
e3	12	2.25	
e4	5	5.10	

RESULTS AND DISCUSSIONS

To determine the intellectual transaction in the classroom of each teacher, the frequency scores on each STOS category over all lessons for that teacher were summed and converted to percentage-use figures as recommended by Eggleston, et al. (1976). For instance, a teacher observed to use a2 in 20 of a total of 80 three-minutes time-sampling units is scored a percentage-use figure of 25%. The mean percentage-use figures by category for all 15 teachers are shown in Table 1 above. Generally, the teachers dominated the lessons, even though there were individual differences observed for each teacher.

The teacher-initiated and maintained behaviours defined by categories a1-7 and (b-c) 1-4 accounted for 88.28% of all transactions while students only initiated or maintained the remaining 11.72%. That the informational aspects of chemistry were emphasised by the teachers in their dominance of intellectual transactions is shown by their high scores on categories (a-c) 1, 2. While a1, 2 deal with questions requiring recall and application of facts and principles to problem solving, b1, 2 deal with teachers' statements of facts and problems and c1, 2 are directing students to sources of information for the purpose of acquiring or confirming facts and principles and solving problems respectively. The low participation of students in cognitive transactions might depend on the teachers' and students' view of the learning environment. Witkin, Moore, Goodenough and Cox (1977) has suggested that social interaction could be improved if there were similarities between students' and teachers' perceptual mode.

Since all the schools were well-equipped with laboratory facilities and all the teachers were professionally qualified and experienced teachers, it would be expected that a student-centred approach involving the engagement of students in laboratory activities would prevail in the classrooms. The evidence that this was not the case indicates the minimal influence of teachers' qualification/experience and/or availability of adequate teaching/learning facilities on teachers' teaching strategies. Perhaps, the teacher's teaching

style depends more on his cognitive style. The teachers' teaching styles were therefore examined according to their cognitive styles.

The teaching style of each teacher could be identified by cluster-analysing the percentage-use figures on each STOS category by teacher or by grouping the STOS categories qualitatively as suggested by Ajeyalemi (1981). The latter approach which has been shown to be equally valid was adopted in this study for lack of appropriate facilities for cluster-analysis. According to Ajeyalemi (1981), three distinct styles of classroom presentation are possible by grouping the percentage-use figures on the STOS categories as follows:

<u>STOS Categories</u>	<u>Style of Presentation</u>
(a - e) ¹	Factual
(a - e) ²	Problem Solving
(a - e) ^{3,4;a6-7}	Experimental

Using this categorisation, the results for each teacher by style of presentation and by cognitive style are shown on Table II. The style of presentation for each teacher is determined by the dimension with the highest percentage-use figure.

To confirm that most teachers were expository in their presentation, it could be seen that many of them used the categories in the factual style dimension more than any other. However, it is clear that eight teachers (1, 2, 3, 4, 6, 7, 8 and 13) were more factually - oriented while seven teachers (5, 9, 10, 11, 12, 14 and 15) were more experimentally-biased in their classroom presentation. By cognitive style, six (6) of the eight (8) factually-oriented teachers (3, 4, 6, 7, 8 and 13) were analytical and two were relational. So also five (5) of the seven (7) experimentally-biased teachers (5, 11, 12, 14 and 15) were relational.

TABLE II
STYLE OF PRESENTATION AND THE TEACHERS'
COGNITIVE STYLES

Teacher	Style of Presentation			
	Factual	Problem solving	Experimental	Cognitive style*
1	61.40	10.28	26.32	R
2	49.24	16.90	33.86	R
3	07.54	00.00	04.46	A
4	58.77	37.72	00.51	A
5	24.42	01.60	53.98	R
6	64.13	13.74	22.13	A
7	03.68	02.27	04.05	A
8	79.19	06.52	14.29	A
9	26.91	20.22	42.87	A
10	29.88	24.68	45.44	A
11	24.69	27.83	47.48	R
12	24.69	32.70	42.61	R
13	44.51	01.19	21.30	A
14	03.34	07.96	38.70	R
15	39.69	09.22	51.09	R

A = Analytical

*R = Relational

The majority of relational-experimental teachers (4) also engaged students more in problem-solving than both the relational-factual and majority of the analytical-factual teachers. On the other hand, the analytical-experimental are more problem-solving in teaching approach than the relational-factual teachers. It would then seem that the more experimental, the more problem-solving a teacher is, in his classroom presentation of science.

This finding seems to contradict Wu's (1968) finding that field-dependent social studies teachers (which are relational according to Ajeyalemi and Busari, 1988) ranked discussion higher than the discovery approach. It may be that field-dependent (relational) teachers seem to use the most appropriate and effective method for any subject. Certainly the discussion method would be more appropriate to social studies teaching than to science teaching, for which the discovery approach is often recommended. The different findings may also be due to the nature of data used in the two studies. While actual classroom observation data were used in the present study, Wu (1968) based his findings on opinions gathered through a questionnaire. What is clear, however, is that a relationship between the teacher's style of teaching and his cognitive style has been indicated in both studies.

The extent of this relationship was determined in this study by correlating the scores on both variables (i.e. the teacher's score on the CST and his highest score on style of presentation). A positive correlation ($r = 0.58$, $df = 13$), was obtained using the Pearson Product moment correlation technique. The significance of this relationship was confirmed by the use of a X^2 test on the frequencies under each variable as shown on Table III ($X^2 = 4.06$; $P = 0.05$)

The analytical teachers were found to emphasise more the informational aspects of chemistry in their presentation and are thus grouped as factual in their styles. On the other hand, the relational teachers emphasised more the experimental style. That is, a significant relationship seems to exist between the teachers' cognitive styles and their teaching strategies. Further studies involving more science teachers and teachers of other subjects would be needed before any conclusive remarks can be made.

TABLE III
RELATIONSHIP BETWEEN TEACHERS' COGNITIVE
STYLE AND TEACHING STRATEGY

Cognitive Styles	Factual Presentation	Experimental Presentation	Total	X ²
Analytical	6	2	8	
Relational	2	5	7	
Total	8	2	15	4.06*

* Significant at .05 level

CONCLUSION AND IMPLICATIONS

Evidence from this study has shown that, even though factors such as adequacy of laboratory facilities and quality of teachers may play some vital roles in determining the teaching strategies employed by chemistry teachers, a major determinant of teaching behaviour seems to be in the teachers' cognitive styles.

There are implications of these findings for practising teachers, teacher educators and curriculum developers. Every individual in any educational system has his own preferred style of attending to tasks, whether in constructing and developing the task, implementing the task, or learning the task. For teacher-education, the cognitive styles of prospective teachers need to be identified with a view to planning programmes that would widen the perceptual modes of prospective teachers, so that they may cope with students of differing cognitive styles. Such an intervention would also aid the teachers in the proper implementation of the school curriculum.

The guided-inquiry approach which is activity-oriented is usually recommended for science teaching and relational teachers have been seen in this study to involve students more in practical and problem-solving activities than in information-giving. It would be worthwhile to determine in further studies, how the analytical cognitive-styled teacher (who seems to be in the majority) could be trained to emphasise more the strategies employed by the relational teacher. This may eventually lead to better students' achievement in science. As studies on strategies for cognitive acceleration of concrete-operational students are progressing, perhaps parallel studies on remediation of the deficiencies in the cognitive styles of teachers and students may be of interest.

Also knowledge of a practising teacher's cognitive style, relative to those of his students, may help him in determining the more effective method of encouraging all his students to effectively learn science. This is more important as it may be impossible in reality, to match a teacher to only students of his own cognitive style.

REFERENCES

- Ajeyalemi, D.A. (1981). *Patterns of Cognitive Interactions in Chemistry Classrooms: A Descriptive Analysis of Lessons of some Lagos Metropolis (Nigeria) Secondary School Teachers*. Unpublished doctoral dissertation, University of East Anglia.
- Ajeyalemi, D.A. (1983). A Study of Intellectual Transactions in some Nigerian Chemistry Classrooms and Implications for Nigerian-based Classroom Research. *Lagos Education Review*. 3 (1), 61-75.
- Ajeyalemi, D.A. and Busari, O.O. (1986). Factors Associated with Under-achievement in "O" Level Chemistry: An Investigation into Classroom Processes, Examination Performance, Teacher and Pupil opinions. *Proceedings of the 27th Annual Conference of the STAN*, Owerri, 25 - 30 August, 250 - 256.

Ajeyalemi, D.A. and Busari O.O. (1988). The Relationship Between the Field-independent/dependent and the Analytical/relational Cognitive Style Categorisations. *Journal of Educational Leadership*, 3 (1), 197 - 203.

Akinmade, A. and Adisa, O.A. (1983). A Study of Students' area of Difficulty in Chemistry. *Nigerian Journal of Curriculum Studies*, II (2), 83 - 96.

Alonge, E.I. (1986). Teaching Chemistry to Large Classes: an Exploratory Study. *Journal of Research in Curriculum*, 4 (2), 29 - 38.

Bajah, S.T. (1980). A Diagnostic Study of Students Difficulties in Coping with the Mole Concept in Chemistry. *Hong Kong Science Teachers Journal*, 8 (1), 86 - 98.

Berkheimer, G.D. and Lott, G.W. (1984). Science Educators' and Graduate Students' Perceptions of Science Education Objectives for the 1980s. *Science Education*. 68 (2), 105 - 116.

Busari, O.O. (In Press). Towards the Improvement of Quality of Teaching/learning of Integrated Science: Teachers Perceptions of some Determinants. *Journal of Science Teachers Association of Nigeria*.

Coop, R.H. and Brown, L.D. (1970). Effects of Cognitive Style and Teaching Methods on Categories of Achievement. *Journal of Educational Psychology*, 61, 400 - 405

Eggleston, J.F. Galton, M.A. and Jones, M.E. (1975). *A Science Teaching Observation Schedule*. London: Macmillan.

Eggleston, J.F., Galton, M.A. and Jones, M.E. (1976). *Processes and Products of Science Teaching*. London: Macmillan.

Fish A. & Goldmark, B. (1966). Inquiry Method; Three Interpretations. *Science Teacher*, 33 (2), 13 - 15.

Guilford J.P. (1980). Cognitive Styles: What are they? *Educational Psychology and Measurement*, 40 (1), 1 – 40.

Kagan, J. Moss, H.A. and Siegel, J.E. (1963). Psychological Significance of Styles of Conceptualization. Basic Cognitive Process in Children. *Monograph of the Society for Research in Child Development*. 28 (1), 73–112.

Kempa, R.F. and Dube, G.E. (1973). Cognitive Preference Orientations in Students of Chemistry. *British Journal of Educational Psychology*, 43, 279 – 288.

Ogunyemi, L. (1973). Cognitive Styles and Students Science Achievement in Science. *Journal of Experimental Education*, 42 (1), Fall, 57 – 63.

Saracho, O.N. (1980). The Relationship Between the Teachers Cognitive Style and Their Perceptions of their Students' Academic Achievement. *Educational Research Quarterly*, 5 (3), 40 – 50.

Science Teachers Association of Nigeria (1970). *Curriculum Development Newsletter No. 1*. Ibadan: STAN

Shuaibu, M. J. (1979). *Teacher Methodology and its Relationship with Science Curriculum Objectives in Kaduna State, Nigeria*. Unpublished doctoral thesis, Ahmadu Bello University, Zaria, Nigeria.

Tamir, P. and Kempa, R.F. (1978). Cognitive Preference Styles Across Three Disciplines. *Science Education*, 62, 143 – 152.

Teibo, B.O. *An Investigation into the Problems Encountered by Nigerian Secondary School Pupils in Learning Chemistry*. *Journal of Science Teachers Association of Nigeria*, 13 (3), 71 – 80.

Ugwu, I.E. (1980). *An Investigation into the Teaching Styles of Secondary School Biology Teachers in Anambra State of Nigeria*. Unpublished doctoral dissertation, University College, Cardiff, U.K.

Witkin, H.A. (1950). Individual Differences in ease of Perception

of Embedded Figures. *Journal of Personality*, 19, 1 - 15.

Witkin, H.A. (1967). A Cognitive Style Approach to Cross Cultural Research. *International Journal of Psychology*, 2, 233 - 250.

Witkin, H.A. Moore, C.A. Goodenough D.R. and Cox, P.W. (1977). Field-Dependent and Field-Independent Cognitive Styles and their Educational Implications. *Review of Educational Research*, 47, 1 - 64.

Wu, J.J. (1967). Cognitive Style and Task Performance: A Study of Student Teachers. *Dissertation Abstracts International*, 29, 176A (University Microfilms No. 68 - 7408).

APPENDIX
CATEGORIES OF THE SCIENCE TEACHING
OBSERVATION SCHEDULE ¹

(Eggleston, et al 1975)

1. TEACHER TALK

1a Teacher asks questions (or invites comments) which are answered by:

- a₁ recalling facts and principles
- a₂ applying facts and principles to problem solving
- a₃ making hypothesis or speculation
- a₄ designing of experimental procedure
- a₅ direct observation
- a₆ interpretation of observed or recorded data
- a₇ making inferences from observations or data

1b Teacher makes statements:

- b₁ of fact and principle
- b₂ of problems
- b₃ of hypothesis or speculation
- b₄ of experimental procedure

1 Any of the 23 behaviour categories may occur in each three minute time sampling unit. Regardless of the frequency of occurrence of any behaviour in each time unit, it is coded only once in that time unit.

1c Teacher directs pupils to sources of information for the purpose of:

- c₁ acquiring or confirming facts or principles
- c₂ identifying or solving problems
- c₃ making inferences, formulating or testing hypotheses
- c₄ seeking guidance on experimental procedure

2. TALK AND ACTIVITY INITIATED AND/OR MAINTAINED BY PUPILS

2d Pupils seek information or consult for the purpose of:

- d₁ acquiring or confirming facts or principles
- d₂ identifying or solving problems
- d₃ making inferences, formulating or testing hypotheses
- d₄ seeking guidance on experimental procedure

2e Pupils refer to teacher for the purpose of:

- e₁ acquiring or confirming facts or principles
- e₂ seeking guidance when identifying or solving problems
- e₃ seeking guidance when making inferences, formulating or testing hypotheses.
- e₄ seeking guidance on experimental procedure



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